

When knowledge is not enough: the phenomenon of goal neglect in preschool children

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Abstract

We argue that the concept of goal neglect can be fruitfully applied to understand children's potential problems in experimental tasks and real-world settings. We describe an assessment of goal neglect developed for administration to preschool children, and report data on two measures derived from this task alongside the Dimensional Change Card Sort (DCCS) and an Opposite-colour response-inhibition task. The propensity to neglect initial task cues was uniquely linked to response-inhibition, while neglect of a later cue was uniquely linked to the DCCS. Additional evidence suggests that recovery from neglect can occur, and shows that goal neglect varies with the cognitive transparency of the signifying cue. Data demonstrate the importance of, and place constraints on, current theories of information-regulation, and foreground the notion of graded representations in working memory and executive functioning.

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The hallmark of the cognitive revolution, to the extent that it existed (Greenwood, 1997; Leahey, 1992), has been the specification of information-processing models. Broadbent (1958) exemplified this approach, attempting to capture the flow of information from the point when stimuli initially make an impression on sensory registers through to response actions. More recently, however, cognitive psychology has increasingly focused on information-regulation, considering the mechanisms for controlling mental representations and higher order goals. Whilst part of the information-processing approach, this more recent emphasis recognises the potential for both endogenous and exogeneous influences to modulate behaviour.

Information-regulation is partly synonymous with “executive functions” (Lehto, Juujarvi, Kooistra, & Pulkkinen, 2003; Miyake et al., 2000). These include, for example, the ability to withhold responses to stimuli that would otherwise be produced because of prior associations. Our contention, however, is that such regulation can only occur when behavioural goals or plans are represented with sufficient completeness and strength. That is, goals must be properly represented and functionally available so that cognition can be regulated towards their accomplishment (see also Zelazo, Carter, Reznick, & Frye, 1997). This forms an under-researched area, and we seek to understand better the processes involved in young children’s goal representation by studying instances of *goal neglect*.

With reference to adult goal-directed behaviour, Duncan, Emslie, Williams, Johnson & Freer (1996) proposed the term goal neglect, “to describe disregard of a task requirement, even though it has been understood.” (p. 265). This concept was argued to be relevant to the behaviour of frontal patients, for whom “there is a mismatch between what is *known* of task requirements and what is attempted in behaviour” (ibid). Duncan et al. (1996) asked adults to perform a speeded monitoring task with a number of sub-elements. Participants were directed by a central cue (“WATCH LEFT” or “WATCH RIGHT”) to one of two locations on a computer screen and within a rapidly changing sequence they attempted to identify letters whilst ignoring digits. A second central but abstract cue (a plus or minus symbol) briefly appeared and directed participants to one or other stimulus streams. Duncan et al. found goal activation failure among some participants; the second cue - the second-side-instruction – was systematically ignored when it called for a change in monitoring location, even though participants knew that they should respond to the cue.

We are not aware of published research that has directly mapped the concept and paradigm of goal neglect to the behaviour of preschool children. This is potentially an important lacuna. The goal neglect paradigm combines the ‘endogenous’ selective control of behaviour towards an experimentally defined goal together with a seemingly sporadic ‘exogenous’ cue in the form of the symbolic second-side-instruction. Added impetus for investigating whether and why children might show goal neglect comes from developmental arguments that representations

are not all-or-none, but vary continuously in their strength (e.g., Munakata, Morton & Yerys, 2003). This approach suggests that there is more to the implementation of goals than their representation *per se*. Moreover, there is plentiful anecdotal evidence that children are sometimes unsuccessful when asked to carry out prospective actions at particular times (when such and such happens, do X). They may ignore the instruction at the point of performance. This adds further weight to the possibility that goal neglect may represent an important concept for cognitive development.

Moreover, there is a striking potential overlap with an independent theoretical framework that has been intensively investigated, the Cognitive Complexity and Control (CCC) model of development. CCC theory is also fundamentally concerned with explaining “dissociations between action and explicit knowledge” (Zelazo, Frye & Rapus, 1996, p. 37) offering an explanation for “situations in which children act inappropriately despite knowing what to do” (ibid., p. 38).

CCC theory has been articulated with respect to the Dimensional Change Card Sort (DCCS). Children sort bivalent cards into one of two trays, with the sorting criteria changing half way through the task from one dimension to another (e.g. from sorting by colour to sorting by shape). Children are made aware of the change in the sorting dimension, and they generally display good knowledge of the new ‘sorting rules’ if they are verbally interrogated. Despite this, 3-year-olds typically struggle to sort cards correctly by the post-switch rules, a process that is eventually mastered by the age of 5. According the CCC theory, “an increase in complexity between 3 and 5 years of age permits children to use a higher order rule to determine which of two

incompatible rules to use. In the card sort task, 3-year-olds know the preswitch rules; they also know the postswitch rules. However, in the absence of a higher order rule that operates on these two rule pairs, 3-year-olds cannot make a deliberate decision about which rule pair to use and they persist in using the rules that are most strongly associated with the task.” (ibid., p.41). This view has been supported in later work (see Zelazo, Müller, Frye & Marcovitch, 2003).

At one level, goal neglect and DCCS paradigms represent very similar phenomena: knowledge about task requirements in general is not translated into appropriate behaviour at the specific point at which it is required. However, the theoretical accounts are rather different. Duncan et al. (1996) suggest that goal neglect arises from the failure to represent the mapping between cues and actions with sufficient saliency (and Kane, Conway, Hambrick & Engle, in press, link adult goal maintenance to working memory capacity; see also Marcovitch, Boseovski & Knapp, in press). Zelazo and Frye (1998), in contrast, argue that DCCS errors occur when children cannot embed rule sets into a hierarchical structure. There are alternatives to this embedded rule account, that focus instead on the sequential demands of moving from one task phase to another (e.g. Kirkham, Cruess & Diamond, 2003; Munakata & Yerys, 2001; Perner & Lang, 2002; Towse, Redbond, Houston-Price & Cook, 2000). However, these different explanations often make overlapping predictions for DCCS performance, which highlight the value of complementary paradigms.

This discrepancy between a shared descriptive language but different theoretical viewpoints generates a potentially powerful opportunity. Of course, there

are substantial differences in studied populations, in the tasks used, and the conceptual contexts relevant to the two paradigms. Nonetheless there is theoretical leverage to be gained by investigating whether goal neglect and DCCS actually involve just superficially similar concepts, or whether instead they share some commonality. In particular, the DCCS was developed with respect to the requirements of hierarchical rule embedding (*If it is the colour game, and if it is a red card, then...*). However, the adult goal neglect task requires participants to orient their attentional focus in response to an arbitrary cue independently of preceding instructions. Finding a relationship between these two tasks would therefore emphasise the relevance of goal maintenance and implementation as being at least a contributory factor in DCCS performance.

Since the response to a goal-relevant cue involves a change from one mode of behaviour to another ‘mid stream’, we entertained the possibility that inhibitory control is important to prevent perseverative persistence of the existing task set. Inhibitory control may also be important to guide attention on the basis of a transient cue, for example to prevent responding to preferred rather than target stimuli, or prevent responding to all stimuli instead of being selective. Therefore, we also administered a Stroop-like inhibitory response task (Simpson & Riggs, 2005) to provide a further measure of executive functioning.

Modifications to the goal neglect paradigm were necessary to make the task developmentally appropriate. We specifically developed the selective image naming task as an environment for assessing children. We slowed the pace down (though

preschool children nonetheless commented that events occurred quickly), reduced the number of stimuli and tried to make the task more motivating (the objective was to help a teddy bear find food rather than have participants respond to stimulus class; stimuli were images of objects rather than alphanumeric symbols). The original task involved incomplete responses; participants reported some stimuli and ignored others. Pilot work suggested that preschool children encountered problems with the need to combine object classification with response decision, and we thus used stimuli that were always potential responses.

We nonetheless preserved core elements of the original, adult, goal-neglect task: in the initial test session, following a centrally presented cue, participants selectively attended off-centre to several screen events. Then a different (and abstract) centrally presented cue appeared that directed participants to attend to one or other stimulus stream. On most (67%) trials this second cue involved a change in the location for the subsequent stimuli. On the remaining trials, the cue maintained the location that was already specified. Events occurred at an externally-paced, regular, rhythm.

In a subsequent stage of the study conducted with a subset of children¹, all experimental trials involved a second-side-instruction that required a switch in the target stimulus location. This was a potentially harder configuration since goal neglect

¹ Testing carried over into the summer vacation period and some children were away for this phase. All available children were tested.

always produces errors. It allowed a focus on children's goal maintenance for the second-side-instruction 'rule' because it consistently cued a change in what is required of children. This stage of the experiment was designed to address two important issues. First, trials explore the impact of task experience on preschoolers' goal neglect. Duncan et al. (1996) reported that across blocks of contiguous trials where participants were reminded of task requirements, recovery from neglect occurred. Goal neglect errors were therefore not inevitable and permanent. Given that children also have the instructions explained to them again their performance might improve too.

Second, trials were designed to examine the relative efficacy of the two types of instruction cue – an abstract patch of colour vs. a more directive arrow. Duncan et al. (1996) described one experiment in which, in addition to the second-side-instruction signal, there was an occasional dot probe that appeared above or below the alphanumeric stimuli. Participants responded by pressing one of two alternative keys (for high or low dot positions). Neglect of the dot response occurred although there was 'spontaneous' behavioural recovery across trials. Duncan et al. speculated that the nature of the cue (a dot located in a high or low position, relative to the abstract "+" or "-" second-side-instruction symbol) influenced the effectiveness of goal activation. That is, participants' tendency to act on a goal-related cue may be related to the transparency or affordance of the stimuli. The mapping between the dot cue and the response was more transparent and consequently, easier to implement as a behaviour. We tested whether goal neglect is influenced by how strongly the stimulus

specifies the appropriate response. In the first session, the first-side-instruction was always an arrow and the second-side-instruction was a coloured square. In the subsequent session we reversed these cues on half the trials.

Method

Participants & Materials

Thirty-four children participated from 3 preschool groups with a mean age of 49 months ($SD=6.6$ months, ranging 36 to 59 months, 16 girls and 18 boys). Parental consent was sought according to preschool procedures. An Apple Macintosh Powerbook G4 (running PsyScript, an experiment generation environment) controlled the SINT. Laminated sheets, cards and two black trays were used for the response-inhibition and DCCS tasks (for full details of DCCS materials, see Towse et al., 2000 Experiment 3). In the final session a sub-sample of 15 children completed additional trials of the selective image naming task (mean age for this group of 8 girls and 7 boys was 46.5 months [$SD=6.85$], range 36 -58 months).

Procedure

In the first test session the Experimenter introduced himself and invited children to play a game on a laptop computer. The game revolved around “Bobo”, a hungry teddy bear shown on screen. Children were asked to help Bobo, who was

looking for food in one of two houses. The houses appeared as blue and red outlines on the left and right of the screen respectively. The experimenter explained that Bobo used a centrally placed (right- or left-facing) arrow and a (blue or red) square to tell children which house he had gone to (these cues formed what Duncan et al., 1996, term the first-side-instruction, and second-side-instruction respectively. In other words, they specified the target response location at the start of the trial and during the trial, respectively). An initial example of each cue was shown to allow children to report verbally where Bobo would be, and examples of food pairs gave them the opportunity to identify just the target food for Bobo (children were told that Bobo would become confused if they named food in the other house). Finally, children were prompted to re-confirm that they knew the relevant task rules before experimental trials began.

The red and blue houses were visible throughout each experimental trial. Each trial began with the first-side-instruction *arrow cue* that appeared for 2 seconds, followed by a 1 second gap. Subsequently 5 food pairs appeared. Each pair contained two different food items shown simultaneously, with one food item shown inside each house for 2.5 seconds in sequence without gaps. The second-side-instruction *colour cue* then appeared for 2 seconds (with a 0.5 second gap, maintaining the pace of delivery) followed by 3 further food pairs at the same pace as before². Figure 1 presents a schematic, annotated, diagram of the event sequence. There were 18 food

² These values report the programmed presentation rate. Actual times would have been marginally slower because of software delays, but these are negligible.

stimulus images, obtained from multiple sources (including public test libraries and Internet sites) and scaled to the same size. The computer sampled these images without replacement until exhaustion, and then resampled the pool.

Children completed 9 trials forming 3 sub-blocks. The experimenter initiated every trial, permitting momentary pauses and encouragement. There was an additional interval after 6 trials, with visual feedback comprising Bobo surrounded by food. Experimental sequences included a second-side-instruction that involved either a cue to shift monitoring location (a ‘switch’ trial) or a cue to maintain the search location (a ‘stay’ trial). Each block involved 1 stay trial and 2 switch trials, randomly ordered.

In a second session, carried out a few days after the first, children completed the red-blue inhibitory and DCCS tasks, in randomized order. We administered a standard DCCS procedure (Zelazo et al., 1996) using stimuli presented by Towse et al. (2000), Experiment 3. Children played a ‘cats and birds’ and ‘reds and greens’ game, in different orders, sorting six test cards into one of two trays according to a shape or colour rule. The experimenter reminded children of the rules, test cards were labeled for children, and they were sorted face down. The second rule set required children to reverse the sorting responses for the test cards. As is typical, after sorting the final card, children were asked two knowledge questions concerning the post-switch rules.

Ten trials of the red-blue inhibitory task adapted the procedure of Simpson & Riggs (2005; see Oh, 2006). Children played a “silly game”, in which the experimenter named a colour, and they touched the opposite colour box on a

laminated sheet in front of them. Thus, with the hand resting on a marked location, if they heard the word “blue”, they were to touch the red box, and vice versa. They were then to return to start location, whereupon the experimenter identified the next word.

In a third session 1-3 weeks later, some children completed further test trials on the selective image naming task. These participants were re-invited to help Bobo on the computer. The task was explained again in full. Each of 6 trials involved, as before, a first-side-instruction, five pairs of food images, a second-side-instruction, and then three further pairs of food images. Trials used the same stimulus set and occurred at the same pace as before. However, all second-side-instructions cued a location switch. Three trials used an initial arrow signal and a subsequent square signal, and three trials used an initial square signal and a subsequent arrow signal; the software compiled, for each child, a random order in which to present these six trials.

Results

Adult goal neglect typically focuses on participants’ failure to respect the second-side-instruction and change monitoring location (Duncan et al., 1996). However, the failure to implement all task relevant instructions can be observed in different ways. Here, we noted two relevant response patterns on each trial. First, whether a child failed to identify correctly the target stimuli on the majority of the five stimuli pairs following the first-side-instruction. Second, we noted whether a child failed to identify correctly the target stimuli on the majority of the three stimuli pairs following the second-side-instruction. Thus, there were two types of goal

neglect reflecting different phases of the task. This pass / fail scoring threshold – based on behaviour with respect to the majority of stimulus pairs – mirrors the criterion used by Duncan et al., 1996. Choosing a non-target stimulus, reporting both stimulus pairs, or failure to respond all constituted goal-directed behavioural lapses (of which the most common was the failure to respond). We also scored performance in terms of the number of behavioural lapses to every stimulus pair following each location cue. However, this alternative (specific) measure correlated very highly with the (global) number of trial errors with respect to the first-side-instruction ($r(32)=.947$, $p<.001$) and second-side-instruction, ($r(32)=.808$, $p<.001$)³. We therefore report the original global measure in the analyses that follow.

In the first session, children completed 9 trials in 3 sub-blocks of the selective image naming task. Since our focus is on *failures* to follow all the task instructions, we express scores in terms of error frequency. The mean number of error trials (goal inappropriate behaviour in response to either the first-side-instruction or second-side-instruction) out of three in each sub-block was 1.3 ($SD=1.2$), 1.0 ($SD=1.08$), and 1.3 ($SD=1.12$). It is apparent that at the level of group performance, children were able to complete some, but not all trials. The mean number of errors in response to the first-side-instruction and second-side-instruction separately was 1.85 ($SD=1.96$) and 1.75 ($SD=1.56$) respectively. Overall performance did not differ across sub-block,

³ We also found a strong association between the failure to respond and the total number of errors, $r(32)=.824$, $p<.001$, confirming the representativeness of the overall measure.

$F(2,66)=2.60, p=.082, \eta_p^2=.145$. Age was not a reliable associate of error frequency, $r(32)=-.181, p=.304$.

The DCCS was measured in terms of sorting accuracy using the first set of (preswitch) rules and the second set of (postswitch) rules (adopting a failure threshold of least 2/6 test cards). As is commonplace, DCCS performance then indicates whether children succeed on both pre- and post-switch phases, or fail on at least one phase⁴; all children of the latter type answered knowledge questions correctly. For alignment with the selective image naming task, the score on the red-blue inhibitory task reflected the number of incorrect responses (out of 10). Children who experienced card sorting difficulties made more mistakes on the red-blue inhibitory task ($M=5.14, SD=3.94$) than the children who succeeded ($M=2.75, SD=3.27$), a difference that was marginally significant, $t(32)=1.93, p=.063, \eta^2=.104$.

Overall, error frequency on the red-blue inhibitory task correlated with the number of error trials on the selective image naming task, $r(32)=.663, p<.001$ and more specifically correlated with the frequency of neglect to both the first- and second-side-instruction ($r(32)=.71, p<.001$, and $r(32)=.36, p=.036$ respectively). Subsequent analysis revealed a dissociation between these two phases of the task. Red-blue inhibitory task errors correlated with first-side-instruction neglect after partialling out second-side-instruction neglect, $r(31)=.67, p<.001$, but not second-side-instruction neglect after partialling out first-side-instruction neglect, $r(31)=.18$,

$p=.328$. This pattern of results is repeated when one also partials out the possible mediating role of age. Figure 2 shows that a dissociation is also found between task phases when one partials out the influence of age and the DCCS.

Overall, problems on the DCCS correlated⁵ with the number of error trials on the selective image naming task too, $r_{pb}(32)=.52$, $p=.002$ and also correlated with the frequency of neglect to the first- and second-side-instruction ($r_{pb}(32)=.37$, $p=.024$ and $r_{pb}(32)=.52$, $p=.002$ respectively). The two phases of the selective image naming task were again dissociated, but the pattern was now reversed. DCCS problems did not correlate significantly with first-side-instruction neglect after partialling out second-side-instruction neglect, $r_{pb}(31)=.24$, $p=.174$ but did correlate with second-side-instruction neglect after partialling out first-side-instruction neglect, $r_{pb}(31)=.45$, $p=.009$ (age did not mediate these effects). Figure 2 shows the differential pattern of associations holds also when one partials out age and the red-blue inhibitory task.

In summary, red-blue inhibitory errors correlate uniquely with neglect of the first signal, while DCCS problems correlate uniquely with neglect of the second signal. While the frequency of neglect to the first and second signals correlated overall, $r(32)=.37$, $p=.029$, they evidently tap different regulatory functions. Moreover, given that each phase of goal neglect correlates with a separate external

⁴ One child produced unusual performance, failing preswitch but passing postswitch trials: yet analysis based on postswitch failures alone produces the same result profile.

⁵ Since DCCS performance is dichotomous, these are point-biserial correlations.

measure, the dissociations in correlations cannot be attributed to differential reliability.

The first session comprised (nine) trials of the selective image naming task in which the second signal either cued a location change or no change. The final session involved fewer (six) trials but they always involved switches. Despite this configuration, children's performance was better on the second assessment. In the first session failures occurred on 45% of trials for the relevant sample of children; this fell to 21% on the final session. This improvement was significant, $t(14)=2.51$, $p=.025$, $\eta^2=.382$. The correlation between the previous and current performance was quantitatively substantial, but not significant with the current sample size, $r(13)=.39$, $p=.185$ (the improved performance in the final session may have contributed to restricted variability).

Analysis of goal compliance confirmed the relevance of cue type. Table 1 shows that children were more prone to behavioural lapses when the coloured square rather than the arrow provided the first-side-instruction or the second-side-instruction. Combining the lapses following the first and second signal, there were significantly more task-related failures associated with the coloured square signal than the arrow, $t(14)=2.17$, $p=.048$, $\eta^2=.252$. Thus the stimulus cues differed in their potency for producing goal-relevant behaviour.

Discussion

We argue that the current implementation of a child-appropriate goal neglect task, the selective image naming task, is useful and tractable. Some, but not all, children succeed at the experimenter paced, computer-based task. It is challenging, but not beyond the capacity of all preschoolers. Moreover, the test environment is sufficiently engaging that young children will undertake a number of somewhat similar trials – over more than one session. The data establish that separable and indeed complementary components underlie performance, by virtue of the dissociations in correlations with different stages of the task.

The data show that second-side-instruction neglect was not uniquely linked to the response inhibition task. However, we do not take this to mean that responding to this signal does not involve inhibition. Just as there are varieties of executive functions (Miyake et al., 2000; Towse & Houston-Price, 2001), we recognize that inhibition is not a uni-dimensional construct (Friedman & Miyake, 2004; Nigg, 2000). We suggest, therefore, that goal neglect to the second-side-instruction is just more strongly related to the ability to shift instructional set than to response inhibition.

In the final session children's performance improved; they made fewer errors even though all the trials involved location switches. This is actually consistent with Duncan et al. (1996), who showed adults' recovery from goal neglect following feedback and prompting. Since the task was explained again in full prior to the experimental trials, we effectively reminded children of all the task goals. We conclude that this helped prompt them to attend to the location signals although we note two further contributory issues. First, children would have been more familiar

with the Experimenter and materials, which may have facilitated performance. Second, since all second-side-instructions mandated a location switch so as to provide a stronger test of goal maintenance the consistent mapping between instructions may have increased the salience of the later cue for children⁶ although adherence to the first-side-instruction improved in the final session too. Whatever the cause the performance improvement echoes the conclusion from Duncan et al. (1996) that neglect does not mean individuals are incapable of implementing the goal, merely that they do not do so. This in turn suggests a possible link with research on children's production deficiencies (e.g. Bjorklund & Harnishfeger, 1990) where a strategy is not elicited even though children can be shown to be able to produce it.

The study also confirms that the configuration of the stimulus item is relevant to the implementation of goal directed behaviour. An arrow is a less abstract cue than a coloured square for attentional selectivity. We suggest that the arrow offers a more direct or leading signal to children to respond to just one of a pair of visual images. These results echo the deployment of a dot probe task by Duncan et al. (1996), and they endorse the notion from Munakata, O'Reilly & Morton (in press) that children's mental representations take graded rather than absolute values. That is, it is not sufficient simply to have a mental representation, *per se*. Instead one requires a sufficiently strong representation combined with a suitable exogenous signal so as to affect information processing. In this context, an arrow is stronger than a colour (a

⁶ Duncan et al. (1996) similarly note that drawing attention to the goal requirements can affect task success.

description that is consistent with, for example, the perspective from natural and conventional symbols in Hala & Russell, 2001).

To succeed on the selective image naming task, children must implement a number of goal relevant behaviours. In the first phase of the task, they must encode and represent the initial signal. They must also look at the relevant spatial location and report just the stimulus that appears there. Children sometimes gave no report at all, and sometimes they reported the inappropriate stimulus instead of or as well as the target. Inhibiting the temptation to respond to the visual onset of stimuli (choosing to respond selectively instead), or allowing attention to be captured by object onsets, may contribute to the association with the red-blue inhibitory task.

Subsequent task behaviour – whether children take appropriate account of the second signal, a colour patch – is linked instead with the DCCS. We suggest that both tasks require adequate representations of the relevant goal state (the implications of the second-side-instruction in the former task or the change in rules in the latter). This association addresses one of the important questions motivating the present work; the apparently similar language in describing dissociations between behaviour and action in the DCCS and goal neglect paradigms *is* more than coincidental. We argue that both paradigms emphasise how knowledge itself is not enough to produce goal-directed behaviour (see also Marcovitch et al., in press). To be effective, internal goals in the selective image naming task must be activated and salient, while the external eliciting signals must also be encoded and appropriately mapped onto those goal representations.

A comparison of the two tasks may well help to reveal patterns of performance in each. There is likely to be an important dynamic between the endogenous representations of a goal and the exogenous stimuli that are relevant to it, such that some external cues have greater imperative force than others, as found in the final session. This implies that both the selective image naming task and DCCS place demands on the adequate representation of the goal state. In the former, children need to do more than notice the colour patch. They must translate its significance (red = report images in the red house, blue = report images in the blue house), as well as often overcome any inertia or perseveration merely to report from the current stimulus location. They must also maintain the goal of reporting the target object rather than fall back to a more passive monitoring state.

Mapping this perspective onto DCCS performance, one might propose that children need to do more than learn the new rule information (e.g., if the card is *a car*, it must be placed in the right-hand tray). Children must represent the now-relevant dimension in the test cards (that the card is a ‘car’), as well as overcome any inertia or perseveration to use preswitch sorting patterns (such as thinking about the card in terms of colour). This line of thinking does not rule out a CCC explanation in terms of embedded *task rules*, yet it focuses on the possibility that DCCS success depends on children making good their understanding of what *test cards* signify (Kirkham et al., 2003; Towse et al., 2000). It is therefore especially compatible with the view that children’s representations in the goal neglect and DCCS tasks are graded, not all or none. Just as Munakata, et al. (in press) argue that DCCS information may be

represented at a level sufficient for responses to direct questioning but insufficient for their deployment on sorting trials themselves when conflict is present, the present evidence suggests that some cues may be sufficient to trigger behaviors whilst other cues –for the same behavior –do not.

In conclusion, we argue that studying goal neglect, via the selective image naming task, provides valuable insights to the production of goal-directed behaviour in young children. The present data demonstrate that task performance can be coherent, interpretable, and multi-faceted. Performance on this task can help to advance our theoretical and conceptual understanding of the organization of representations, and raise a number of questions for future research to address. The results illustrate the potential of the paradigm to constrain theories about the regulation of information-processing, and complement existing techniques for learning how children come to develop executive skills.

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Table 1. Frequency of behavioural lapses in the second administration of the selective image naming task as a function of cue type and task phase. Standard deviations in parentheses.

Response to the first-side-instruction	
Arrow signal	.20 (.41)
Colour signal	.47 (.99)
Response to the second-side-instruction	
Arrow signal	.33 (.73)
Colour signal	.53 (.64)

Figure Captions

Figure 1. Schematic representation of the sequence of events in the Selective Image Naming Task. FSI = First Side Instruction; SSI = Second Side Instruction.

Figure 2. Relationship between the selective image naming task and other Executive Function tasks. Variables depicted with broken lines (e.g. children's age) represent those partialled out of the specified association. SINT FSI = compliance with the first-side-instruction in the selective image naming task; SINT SSI = compliance with the second-side-instruction in the selective image naming task. Asterisks represent significant associations.



